Iowa City, Ia.; Agricultural Experiment Stations—College Park, Pa.; Lexington, Ky.; Columbia, Mo.; Agricultural College, Michigan; Madison, Wis.; Denver, Colo.; Berkeley, Cal.; Instituto Medico Nacional, Laminas, Mexico.

Photograph for the Society's Album was received from Dr. W. G. A. Bonwill, Philadelphia.

The following death was announced: Hon. William Strong, Washington, D. C., August 19, 1895.

A paper was read on the "Identification of Colored Inks by the Absorption Spectra," by Dr. C. A. Doremus, of New York.

Prof. Cope made some remarks on the figures of men and animals on a tablet from Nippur, and expressed the opinion that the men were of the pure white race and not mixed.

Dr. Brinton followed, corroborating the views of Prof. Cope.

Pending nominations 1346 and 1347, and new nominations 1348 to 1362, were read. On motion, the nominations of non-residents were referred to Council.

The Curators reported on the collections of coins and medals formerly deposited with the Numismatic Society, but at present deposited in the Pennsylvania Museum and School of Industrial Art. All the articles had been accounted for with but two exceptions.

The report was received, and the Curators discharged from further consideration of the subject.

The rough minutes were then read, and the Society adjourned.

The Identification of Colored Inks by their Absorption Spectra.

By Charles A. Doremus.

From the committee appointed by the Society to investigate the various methods for the examination of documents.

(*Read before the American Philosophical Society, April 10, 1896.*)

The substitution of aniline dyes for other coloring matters in the preparation of colored inks, especially red, necessitates the adoption of means for their recognition.

A characteristic feature of the aniline colors is a surface iridescence, distinguishable even in the thinnest layers.

The beetle bronze is unmistakable. The iridescence is frequently complementary to that of the color—thus green to red.

Many of these inks also show fluorescence. This is especially developed in very dilute solutions. Highly attenuated solutions of fluorescein behave differently to light from concentrated ones. The dichroism of concentrated solutions is quite distinct from the fluorescence obtained by dilution.

Concentration appears to destroy fluorescence. This is also true of glass. Glass containing ten per cent. of uranium oxide would not be recognized as the uranium glass whose greenish yellow fluorescence is so well known.

The writer was led to investigate many of these properties in connection with a case tried in New Jersey in 1891.* The circumstances were briefly as follows: Mr. George P. Gordon, of printing press fame, left a large estate by a will dated 1873. This will was rejected because the subscribing witnesses would not swear to the execution of it. The case became one of intestacy and was taken in charge by the Public Administrator of Brooklyn. The estate was then settled with the parties named in the will. The widow and a daughter by a first wife were the chief beneficiaries. The daughter died in 1890 and her will was offered for probate in New York city. A contest took place. The contesting attorneys received a letter from a party stating that he had seen a notice of the contest in the daily press and that they would hear something to their advantage should they communicate with him. This led to the finding (?) in a garret of a will purporting to have been executed by George P. Gordon in 1868. The subscribing witnesses to this document were all dead. The wife and daughter had also died before this alleged will was brought to light. This document was proved *ex parte* in New Jersey and ancillary probate was allowed in New York. The instrument was also filed in Trenton. The legal representatives of the heirs of the wife and daughter contested the genuineness of this will. The proponents were parties contesting the daughter's will to whom was joined Henry C. Adams, who claimed to have drawn the will and who would be benefited should it be established. For a time the litigation was conducted on the part of the contestants in attempts to prove by the handwriting that the signature of the testator was a forgery. The case to this point rested entirely upon expert testimony, when Adams brought forward a draft of the will purporting to have been made in July, 1868, and offered it in evidence. This draft was interlineated and amended with red ink. When submitted to expert chemists they pronounced the ink one of some aniline color and from general appearances eosine. The controversy then centred on the

*The Prerogative Court of the State of New Jersey in the matter of the Probate in solemn Form and the Last Will and Testament of George P. Gordon, deceased. *Jersey City News Press*, 1891.

question as to whether the ink was eosine or not. Experts were called for both sides and the writer was among those retained by the executors. As the right to use reagents on the document was denied all the preliminary tests had to be of a physical character, though they were afterwards verified by chemical tests in court. My attention had been called several years previously to the black appearance of the lips of players using rouge, one kind of which I knew to be eosine. Eosine is irresponsive to yellow rays and seems almost black in the glare of the footlights. Carmine and other reds retain more of their red color. Experiments were therefore made with different red inks, as carmine, aniline red, safranine, and eosine, and their appearance noted under monochromatic illumination of a sodium flame.

The results were not as pronounced as desired. Recourse was then had to comparing the various inks in strong daylight behind differently colored glasses. The effects were very striking, especially with the aniline inks since they possess iridescence.

Colored glasses also greatly aid in the discovery of their fluorescent qualities.

The ink on the document presented a lustre when illuminated through green glass which was quite different from that of carmine and various aniline inks.

The *fluorescence* of eosine may also be enhanced by the use of blue or purple glass.

These experiments induced the writer to try a spectroscopic examination of inks, both in solution and in form of writing.

A Zeiss micro-spectroscopic eye-piece and low-power lens were used at first, then a higher power. This test is especially valuable since the document is uninjured.

It requires the brightest sunlight as a source of illumination. The ink is viewed by transmitted light and an absorption spectrum is obtained. When mapped the spectra are found to vary.

This means of identification was, however, not sufficiently developed to enable it to be used in court, nor could it be shown because of the absence of proper facilities.

At court the preliminary examination of the experts was strengthened by chemical tests applied to the ink on the document and prominently the action of hydrochloric acid which produced a yellow color and by the greenish yellow fluorescent nature of a solution of the ink.

The opinion of the experts for the defense that the ink was eosine was corroborated by several ink manufacturers and a well-known importer of aniline dyes.

In rebuttal it was claimed that the ink was aurine.

It was necessary to break the evidence going to prove the ink to be eosine since that color was not discovered until 1874, eight years after the date of the will. Aurine was, however, in commercial use in 1865, and

as per patent of Henry Ellis, Great Britain, No. 2267. It was not shown, however, that it was purchasable as ink in this country in 1868.

The decision of the Chancellor in favor of the contestants was sustained in 1894 by the Court of Errors and Appeals.

While an alkaline aurine solution produces an ink very similar to eosine in many properties and reactions, it differs widely in others and especially in not having greenish yellow fluorescence of eosine in diluted solution and in not showing the same absorption spectrum and derivative spectra.

The accompanying maps show the spectra observed with thin layers of various inks. A Donné lactoscope proved very useful in varying the thickness of the layer until the most characteristic appearance was obtained. The same absorption bands were afterwards recognized when pen marks made with these inks were examined under a microscope to which a Zeiss spectroscopic eye-piece was adjusted.

The spectroscopic examination of the ink while on the document should be followed whenever allowed by observations of the spectra produced when the ink is subjected to the action of chemicals.

Very marked changes occur, and since even colorless solutions may show absorption bands this means of identification possesses the double advantage of an accurate physical test without injury to the document together with a combined chemical and physical test where the application of reagents is permitted.

Stated Meeting, April 17, 1896.

President, Mr. FRALEY, in the Chair.

Present, 20 members.

Mr. Georges Bertin, a newly elected member, was presented and took his seat.

Minutes of meeting of April 10 were read and approved.

Letters of acknowledgment were received from the Public Library, Wellington, N. Z. (147); Universitatis Lundensis, Lund, Sweden (147); Profs. Friedrich Müller, Edward Suess, Vienna, Austria (148); Naturforschende Gesellschaft, Bamberg, Bavaria (147); K. Sächs. Meteorol. Institut, Chemnitz (148); Verein für Erdkunde, Dresden, Saxony (147, 148); Wetterauische Gesellschaft, Hanau, Germany (147); Verein für